

A Framework for Halal Products Checking Interactive Application with OCR and AR Technologies

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Abstract—E-Code uses a numbering system to represent the ingredient of the food. The consumer could identify the halal status of the food by using the E-Code. One of the problems that have been identified in this study is the consumers have little knowledge about the E-Code. Therefore, users often have doubts about the halal status of the product. Nowadays, the integrity of halal status can be doubtful due to the actions of some irresponsible people spreading false information about a product. This paper proposes a framework for an interactive application for halal products using Optical Character Recognition (OCR) and Augmented Reality (AR) technologies. The OCR and AR elements were integrated successfully using the proposed framework. An application was developed based on the framework which can help users to identify the information content of a product by scanning the E-Code label or by scanning the product's brand to know the halal status of the product using OCR and AR technologies. In this application, E-Code on the label of a product is scanned using the OCR technology to display information about the E-Code. The product's brand is scanned using augmented reality technology to display the halal status of the product. The findings revealed that users agreed that the application is useful, easy to use and they are satisfied with it.

Index Terms—Augmented Reality; Framework; Halal; Optical Character Recognition.

I. INTRODUCTION

A framework will map out the procedure required in the related field of the study based on point of view from previous research and through observation on the research subject. There are four steps in order to prepare a conceptual framework which begins by deciding the study field specifically, performing the literature review, isolate the important variables and design the framework. In developing an application for the halal product, a framework is carefully constructed to provide a base for the design and development process.

“Look for the halal is mandatory for every Muslim” (HR adDailami, Musnad al-Firdaus AlJami ‘asSaghier [1]) as a Muslim, Prophet Muhammad guides us to choose halal products. The differences between halal and haram foods are the ingredients of the food, food processing techniques and the product management. For example, the beginning of food ingredient preparation to the end of food package method must be based on Islamic law [2]. Muslims are facing difficulty to identify the halal status of a product. The first factor is the user has little knowledge about the E-Code.

Although the E-Code information is easy to get nowadays, some people lack knowledge about the additives represented by the E-Code because they are not familiar with the E-Code and the scientific name of the additive. Nowadays, it is easy for the user to get information on the Internet [3]. However, irresponsible people often create issues on the halal status of a product and cause confusion to the consumer by disseminating fake information. E-code provides information of food additive in food products. According to Jakim, the additive is safe to eat because it is a substance added to food in small quantities to help keep the quality of storage, processing, preparation and packaging of the product [4] but for Muslims, they have to choose the product with additives that are halal. Based on food product labels, consumers can identify the product status whether halal, haram or mashbooh [5] if they have knowledge about the ingredient. Most of the websites that provide halal information through E-Code are unofficial websites which are not reliable. This factor is one of the reasons why the consumer is in doubt to believe the information provided. All these factors make it difficult for consumers to identify the halal status of a product that containing the additive. They need some assistance from reliable websites or mobile application.

A recognition system is needed to identify the halal status of a product [6]. Therefore, this study aims to propose a framework for halal products checking mobile application using OCR and AR technologies and develop a mobile application base on it. Users who are using the mobile application is able to get information of the E-Code through scanning the E-Code using Optical Character Recognition (OCR) technology. Another feature available in the system is a module that is using AR technology to identify and show the halal status of a product where the user needs to scan an image or marker which is the brand's logo of the product. The mobile application of this study also provides manual search for the E-Code where the user can input the E-Code in a provided edit text field or use scrolling method on the list view to get information about the E-Code. Furthermore, the evaluation of the usability of the developed interactive mobile application using OCR and AR technology has been conducted. At the end of this study, a framework has been successfully applied to this application. The framework allows users to interact with two technologies which are OCR and AR that has been integrated into an interactive application. This framework also can be used to develop other OCR and AR application.

II. LITERATURE REVIEW

This section discusses the research on optical character recognition, mobile augmented reality, analysis of existing OCR framework and basic AR framework.

A. Optical Character Recognition

Optical Character Recognition (OCR) is a technology that can generate text from various types of documents such as a paper document, images and PDF files. Distortion at the edges and the lighting factors affect the accuracy of the OCR algorithm. Those are the challenges for the OCR algorithm invention. The process OCR to get data from a text document are the scanning, image preprocessing, segmentation, classification, identification and displaying. The scanning is a process in which the image in the form of hard copy format or document will be scanned and stored in the form of image softcopy [7]. Image preprocessing is needed to convert the colour image into the black and white binary image, noise reduction method to reduce the isolated pixels, rescale the images into the predefined size and etc. This is because most OCR algorithms are using the binary data to perform the identification process such as algorithm in [8]. The segmentation is a separation process of the observation area on each letter, number or symbol from the background based on data that has been produced by image preprocessing process. The classification is a process in which the desired character will be classified in the category of numbers, letters or symbols and then utilize the corresponding identification method to recognize the character. Displaying process is the last process after the identification process in which the characters in the image data has been converted into a text document that can be altered and displayed. The resulting output is digital text data that can be changed by the user. Users can change the generated text data from OCR because it does not necessarily produce the accurate text result. The accuracy of the result can be affected by several factors such as the clearness of the picture, hazy light camera and the different text sizes.

B. Mobile Augmented Reality

Augmented Reality (AR) is a combination of virtual environments between the real object and virtual object in one interface. AR allows users to see the real world, with virtual objects superimposed upon or composited with the real world [9]. AR is a reality that mixes real environment with the virtual environment. AR often incorporate real objects into virtual environments. Therefore, AR is a supplement for reality, rather than completely replacing it. The concept of Mobile Augmented Reality (MAR) was developed around the mid-1990s, applying Augmented Reality (AR) in truly mobile settings, away from conditioned environments, confined spaces, and the desktop [10]. MAR introduces a novel interaction system between the user and the system where users point their devices in the direction of an interesting item and the camera augments the display with additional information about the environment [10]. Each AR-based application has a similar workflow as shown in Figure 1, which shows a workflow-based application that was reviewed by [11]. AR acquire an image from a camera, these markers should be separated from the background. After that, the contours of these markers will be extracted. The translation matrix for the virtual object can be calculated based on the contours and is used to display objects on the

marker. Basically, there are three elements that are needed in AR applications. The first element is the camera, it is necessary to capture the real environment. The second element is the display, it is necessary to show the final result. The final element is the device, it must have the power central processing unit (CPU) to further generate 3D objects. There are many devices available have met this requirement.

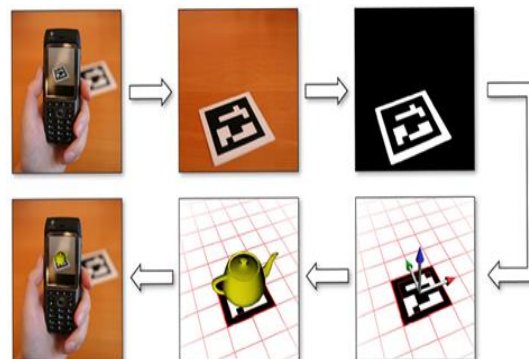


Figure 1: Augmented reality application workflow (Domhan [11])

C. Analysis of Existing OCR Framework

Between 1995 and 2006, Tesseract OCR engine was one of the top 3 engines in the 1995 UNLV Accuracy Test [12]. However, there was very less activity in Tesseract before it was open-sourced by HP and UNLV in 2005. After that, Tesseract is sponsored by Google in 2006 [12]. Through the years, there are many studies that have been used Tesseract as their OCR engine. Table 1 shows three of the studies that used Tesseract as their OCR engine and their elements in OCR framework such as image-preprocessing, text detection and recognition, post-processing, speech Synthesis and etc.

Table 1
Comparison Between Existing Applications

Title	Authors	Elements in OCR Framework
Open Source OCR Framework Using Mobile Devices	Steven Zhiying Zhou, Syed Omer Gilani, Stefan Winkler (2008)	<ul style="list-style-type: none"> Image-Preprocessing Text Detection and Recognition Post-Processing Speech Synthesis
An open source Tesseract based Optical Character Recognizer for Bangla script	Md. Abul Hasnat, Muttakinur Rahman Chowdhury, Mumit Khan (2009)	<ul style="list-style-type: none"> Preparing Training data Preprocessing the document image Preparing Tesseract supported image Performing Recognition using Tesseract engine Post-processing the generated text output
Multilingual OCR Research and Applications: An Overview	Xujun Peng, Huaigu Cao, Srirangaraj Setlur, Venu Govindaraju, Prem Natarajan (2013)	<ul style="list-style-type: none"> Binarization Page segmentation Text line finding Word/Character segmentation Script identification Recognition Modelling

D. Basic AR Framework

The basic process for Augmented Reality system is shown in Figure 2 where the camera will capture the video as a series of the image frame. The frame will be analysed to track the marker/object in order to render the virtual elements such as

video and 3D object on top of the marker. After that, the output will be displayed to the user.

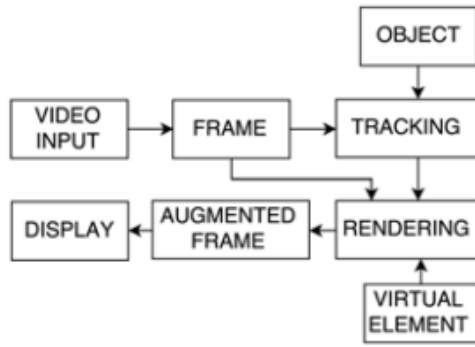


Figure 2: Basic framework for augmented reality [13]

E. Analysis of Existing Application Halal Checking

Analyse of existing applications is necessary to study the weakness of the existing application in order to develop a good application that satisfies user's needs. Table 2 shows some similarity in the features found in the existing halal applications. All halal check applications provide only manual search function and use English as the language of instruction. Each application has a different user interface for displaying information. Most of the applications use scrolling method for performing a search about the E-Code information. In addition, each application displays the name and type of the additive E-Code. Three out of four applications display the halal status of the E-code to the user. All of the applications use a manual searching method by key in product's brand and E-Code. Therefore, an application that uses OCR and AR technology is needed to assist users in order to identify halal products in a convenient way of acquiring the halal status.

III. APPLICATION FRAMEWORK

Figure 3 shows the architecture of this application. For the OCR part, an image will be captured as input image through the camera user interface in the application. The input image will be converted into binary by using adaptive thresholding method. Then the image will be converted into the white text and black background to get the character outline. After that, the character outline will be converted into text lines as Binary Large Object (BLOB) using line and word finding

method. Line and word finding method consist of four steps which are line finding, baseline finding, fixed pitch direction and chopping and proportional word finding. For line finding process, line finding algorithm is used to recognize skewed page without a de-skew process in order to avoid loss of the image quality [14]. It consists of two processes which are blob filtering and line construction. The purpose of blob filtering process is to fit a parallel and non-overlapping model. By processing and sorting the blob will ease the assigning process of the blob as unique text line and reduce the mistake. The line construction process is a process to merge the blob that is overlapping, then place diacritical marks with the correct base to associate some broken characters correctly. Baseline fitting is a process that used a quadratic spline to handle curved baselines. The quadratic spline performs a reasonably stable calculation. However, a cubic spline is better if multiple spline segments are required [14]. To find the proportional word, fixed pitch detection and chopping was used. It consists of two parts which are finding the fixed pitch text and chopping the words into characters. On the other hand, for the non-fixed pitch or proportionate text spacing, the gap between baseline and mean line in limited vertical range will be measured. The gaps between the character that close to the threshold will cause fuzzy and the decision will be made after the word recognition process in phase 2 [14]. Word Recognition consist of two phases. The first phase is a process to recognize each words from text using features extraction and features matching algorithm. The second phase is the process of extracting text from the image. The extracted text will be compared with the texts in the database and the output will be displayed based on the logic decision.

For AR part, the video stream of the camera will scan the product's brand that is used as a marker for AR application. Next, in pose estimation process, the 3D position and orientation of the marker will be identified [15]. Rigid body transformation matrix will be produced from the pose estimation process and it will be used to calculate the marker position in relation to the digital camera. Identify patterns will compare the product brand image's feature with the images that have been stored inside the application to get the marker ID. The information about the product will be retrieved by using the marker ID. If the product is halal, the halal logo will be rendered on top of the product's brand to be displayed to the user.

Table 2
Comparison Between Existing Applications

Application/ Features	E-Halal Halal Additive	Halal Check	Enumbers: Halal, Haram, Doubtful	Halal or Haraam E-codes
User Interface	(Spin list)	(List View)	(Grid View)	(Grid and List View)
Method Search Information	Use symbols to enter the E-Code	Type the E-code and scrolling methods	Scrolling methods to find information about E-Code	Scrolling methods to find information about E-Code
Manual Search	Yes	Yes	Yes	Yes
UI View Results	Status, name and type of additive	Status, name and type of additive	Status, name and type of additive	Status, name and type of additive
Database	Yes	Yes	Yes	Yes
OCR or AR Technology	No	No	No	No

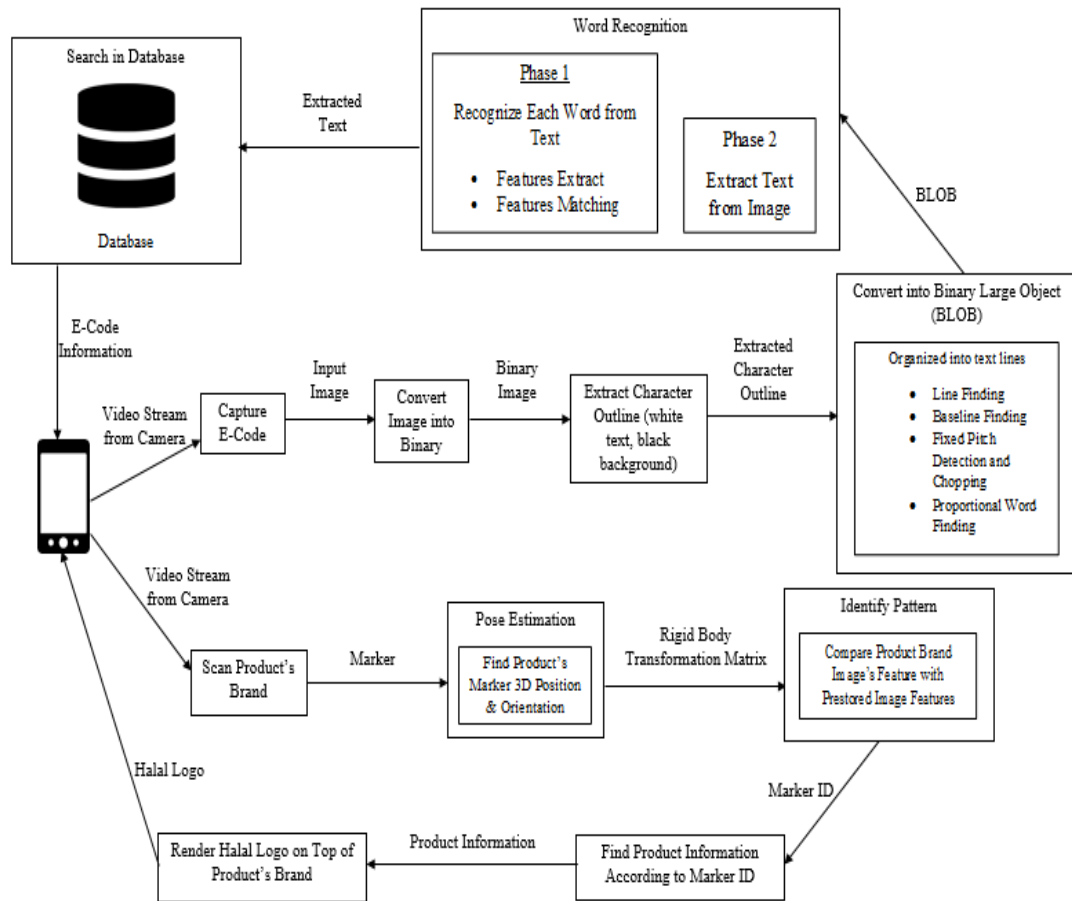


Figure 3: Framework for halal product checking application

IV. PROPOSED MOBILE SOLUTION: OCR AND AR BASED HALAL PRODUCT CHECKING

The proposed mobile application solution comes with three searching functions. The user could search the product information using the manually searching function, scanning the E-Code label and the product's brand. Figure 4 is a flowchart for this application. For the OCR function, users need to click the OCR button to open the camera interface to capture the E-Code that was labelled on the products. The E-Code that has been captured will be processed using OCR algorithm. For the AR function, the user needs to click the AR button to perform the scanning on the product's brand. The scanned logo brand image will go through image recognition algorithm and the virtual information of the product will be displayed using AR technology. The manual searching function required the user to input the E-Code in the edit text or scroll the listview. All of the functions will search data from the database to perform decision logic to provide the result to the user.

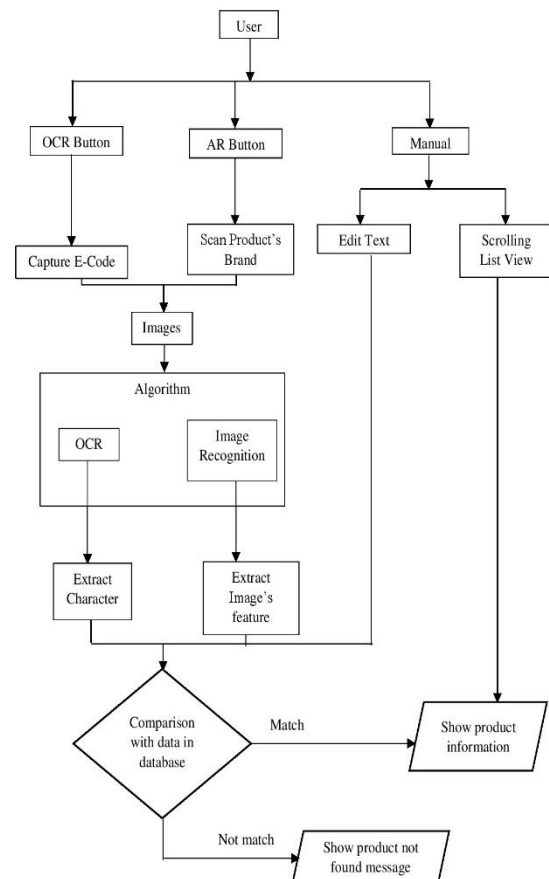


Figure 4: Mobile Application Flowchart

Figure 5 (a) is an interface for the main page of this application. All E-Code contained in the database will be displayed in the form of a list view on this page. To search manually, users must key in the E-Code in the edit text box or the users can use the scrolling method to browse through the list view. The searching results will be shown after users clicked one of the E-Code in list view as shown in Figure 5 (b). In addition, two floating action buttons are provided at the bottom right of the interface page which is OCR and AR scanning function. When the user clicked on the OCR's floating action button, the camera interface for OCR technology will be displayed. When the user clicked on the AR floating action button, the camera interface for AR technology will be displayed. Figure 6 is the user interface for displaying the information about the E-Code if user performs searching using OCR technology. Figure 7 is the interface that appears after user scanned the product's brand. The halal logo is overlaid on the product brand if the product is Halal.

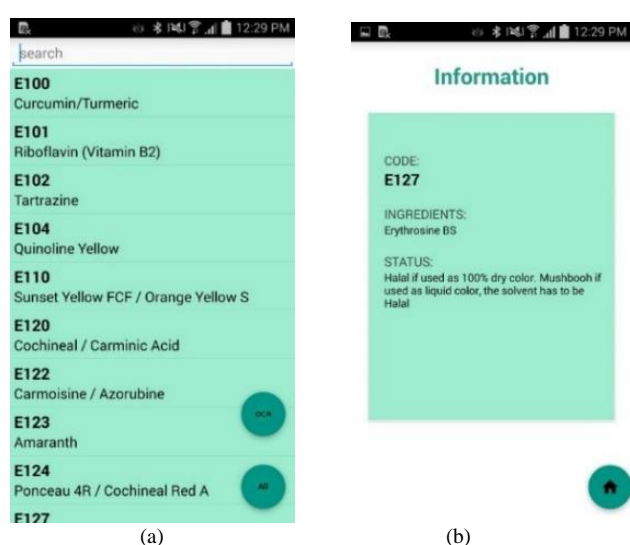


Figure 5: (a) Home screen (b) Information display (manual search)

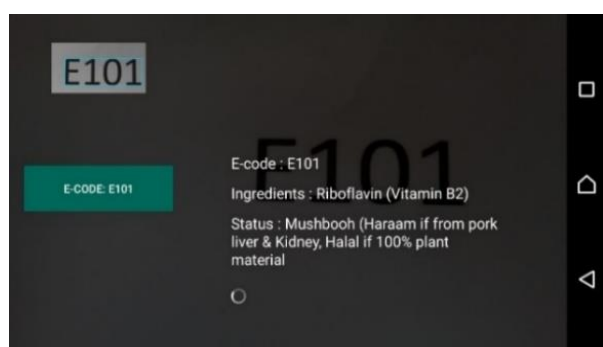


Figure 6: Information display use OCR Technology

V. RESULTS AND DISCUSSION

Usefulness, Satisfaction, and Ease of use (USE) questionnaire and questions from Technology Acceptance Model (TAM) was used as a tool to conduct the evaluation of this application based on a research by [16, 17, 18]. There are three constructs which are usefulness, ease of use and user satisfaction. This work uses all three constructs to analyze the usability of the interactive mobile application using OCR and AR for halal products. The measurement of



Figure 7: Information display use AR Technology

all three constructs is measured with four items in each construct that have been modified to the context of this application.

Usefulness is defined as the degree to which the users believe that this application is useful and can help them to check halal products. Ease of use is referred to the level of easiness for the users to use this application. This is important because it shows how users interact with the application. User satisfaction is related to how the application can be experienced in a variety of situations. User expectations toward the application will give massive effect to user satisfaction.

An evaluation was conducted with 25 respondents consisting of 19 males, 6 females. They were all aged between 22-27 years. The application has been demonstrated using Samsung Galaxy Note 3 which is android phone version 4.4.2 with processor Qualcomm Snapdragon 800, 3GB RAM and 13-megapixel camera. The evaluation session took 25 minutes including an explanation of the mobile application. Every user was given 10 minutes to experience the application and followed by the questionnaire answering section.

The outcome from the questionnaire is shown in Table 3. The range between 0 and 1 is a normal range for proving the reliability of Cronbach's alpha. But, there is no exact lower limit to the coefficient of Cronbach's alpha. The closer Cronbach's alpha coefficient is to 1.0 the greater the internal consistency of the items in the scale [19]. The range of the Cronbach's alpha of the evaluation result is 0.71 to 0.94 and the suggested benchmark is 0.7 [20]. Therefore, all of the items used to measure the constructs are reliable.

The mean for all of three constructs is more than 4.30. Usefulness received the most positive feedback from respondents with 4.64 mean value where the respondents have strongly agreed that the application is useful for users to get information about halal products (mean value 4.76). Overall mean for ease of use is 4.47, it shows that users agree that it is easy to get information about halal products by using the application (mean value 4.68). Lastly, users are satisfied with the application with 4.30 mean value for user satisfaction construct.

Table 3
Evaluation of Conducted Questionnaire (Overall Mean for Each Construct is in Bold)

Construct	Mean \pm SD	Cronbach's alpha
Usefulness	4.64	0.71
U1 The application will help the users by displaying information about halal products.	4.72 \pm 0.46	
U2 The application will save the time of users to get information about halal products.	4.52 \pm 0.65	
U3 The application enables users to get information about halal product quickly.	4.56 \pm 0.71	
U4 The application is useful for users to get information about halal products.	4.76 \pm 0.44	
Ease of Use	4.47	0.72
EU1 I completely satisfied in using the application.	4.44 \pm 0.71	
EU2 I can get information about halal products quickly by using the application.	4.56 \pm 0.71	
EU3 I felt confident to use the application.	4.20 \pm 0.71	
EU4 I found it easy to get information about halal products by using the application.	4.68 \pm 0.55	
User Satisfaction	4.30	0.94
US1 It is easy to interact with the application.	4.32 \pm 0.69	
US2 I found the procedure through the application is clear.	4.40 \pm 0.58	
US3 I found the various functions in the application were well integrated.	4.20 \pm 0.76	
US4 I think that I would like to use the application always	4.28 \pm 0.79	

VI. CONCLUSION

This paper has justified a framework that has been applied to an interactive application. The framework combined the OCR and AR technologies to identify the halal status of a product. An application has been developed based on the framework to help users to get the information about a product and help resolve confusion among consumers. This application provides an option to users whether to search the product information manually or using AR and OCR technology. For manual search, the user can input E-Code in edit text box or scroll the list view interface on the main page of this application. For the search using OCR technology, users must scan the E-Code contained in the product label and for AR technology, users must scan the product brand on the packaging. AR and OCR technology are the current trend technologies that will provide a new experience to consumers and make the searching easy. The results have shown this application gives a lot of benefit to users based on the response from the user which reveal that users are satisfied with this application and it is useful and easy to use. A further research to improve the framework and algorithm is needed in order to enhance the application.

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